

REMARKS

By the present amendment, claims 7-12 are pending in the application. Claim 7 is independent. Claims 1 to 6 are cancelled and withdrawn claims 13-17 are cancelled.

Restriction Requirement

Withdrawn claims 13-17 have been cancelled without prejudice to the filing of a divisional application directed to the subject matter of claims 13-17.

Support For Claim Amendments

Claim 7

Support for steel pipe heated at the austenite-ferrite dual-phase temperature region and quenched can be found, for example, in the specification at page 17, line 25 to page 18, line 1.

Support for fine martensite dispersed at the ferrite grain boundaries can be found, for example, at Fig. 4(b) which clearly shows martensite is dispersed at the ferrite grain boundaries.

Claim 10

See specification, e.g., at page 17, line 30.

§ 102/§ 103

Claims 1 and 7 are rejected under 35 U.S.C. § 102(b) as being anticipated by Kashima et al. (JP 10-176239, English abstract and machine translation) and claims 2-6 and 8-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kashima et al. (JP 10-176239, English abstract and machine translation). These rejections, as applied to the amended claims, are respectfully traversed for at least the reasons set forth below.

The Present Invention

The present invention is a claimed steel pipe with a small Bauschinger effect, comprising a steel base material having a dual-phase structure substantially comprising ferrite and fine martensite dispersed at the ferrite grain boundaries, said steel pipe heated at the austenite-ferrite dual-phase temperature region.

J.P. Patent No. 10-176239

The invention disclosed in the '239 patent relates to a high strength and low yield ratio hot rolled steel sheet for pipe where the steel sheet contains C: 0.02-0.12%, Si: 0.1-1.5%, Mn \leq 2.0%, P \leq 0.05%, S: 0.01%, Al: 0.01-0.10%, and Mo + Cr: 0.1-1.5%; optionally contains Cu, Ni, Ti, Nb, V, Ca, and a balance of Fe and unavoidable impurities; and has a structure composed of martensite and ferrite by 1-20 area %. See, Abstract. This hot rolled steel sheet is produced by the steps of: heating a slab at 1000-1300°C, hot rolling at a finish temperature of 750 -950°C, cooling with a cooling rate of 10-50°C/s, then coiling at 480-600°C. The steel sheet is subsequently formed into pipe, however, further heat treatment after pipe shaping is not suggested or disclosed.

Patentability

The presently claimed steel pipe is heat treated, after pipe shaping, at a temperature corresponding to the austenite-ferrite dual-phase temperature region after, and then quenched. Applicants assert that there is no suggestion or disclosure of heat treatment after the pipe shaping in the '239 patent. The '239 patent is only directed to a hot rolled steel sheet. Therefore, since the heat history of the instantly claimed steel pipe and the '239 steel pipe is quite different, the steel microstructure of the would necessarily be quite different.

Further, the '239 patent discloses that the disclosed steel sheet is heated at a high temperature (1000-1300°C), followed by cooling. During cooling, there is a 100% steel sheet. Applicants submit that an artisan of ordinary skill would understand that ferrite is formed during the cooling phase at the boundaries of the austenite grains of the austenite steel sheet. Thus, the quenching results in a steel microstructure with austenite grains and ferrite at the austenite grain boundaries. Subsequently, the remaining austenite is transformed into martensite, therefore martensite occupies the space of the prior austenite grains. It would be clear to an artisan reading the '239 disclosure that the ferrite is dispersed at the martensite grain boundaries in the '239 steel sheets.

In contrast, the microstructure of the presently claimed steel pipe invention is formed during the heating phase in which the pipe is heated from a low temperature to the austenite-ferrite dual-phase temperature region. Austenite is formed from ferrite grain boundaries, then this austenite is transformed to martensite. Thus, martensite exists at the ferrite grain boundaries, as shown in Fig. 4(b). As described above, the method disclosed by the '239 patent does not result in the structure shown in Fig. 4(b).

Furthermore, a difference in composition and therefore properties results from the presently claimed steel pipe being quenched, or rapidly cooled, to an ambient temperature from the austenite-ferrite dual-phase temperature region. Specifically, the rapid cooling prevents the precipitation of carbon resulting in a greater amount of dissolved carbon remaining in the crystallized structure.

In contrast, the '239 patent discloses that the temperature of the hot rolled steel sheet is held at the relatively high temperature of 480-600°C while the sheet is coiled. See '239 translation, paragraph [0010]. During this cooling, carbon precipitates as cementite and therefore there is little dissolved carbon remaining in the steel.

Dissolved carbon significantly influences the magnitude of the Bauschinger effect because dissolved carbon is known to prevent crystal dislocation and thus reduces the Bauschinger effect. The presently disclosed rapid cooling, or quenching, is advantageous to provide a pipe with a reduced Bauschinger effect compared to the '239 patent. If a steel pipe is formed from the steel sheet of the '239 patent, such a steel pipe would have a big disadvantage with respect to the Bauschinger effect. The advantageous order of Bauschinger effect is as follows: present inventive pipe > '239 patent steel sheet > pipe produced by '239 patent.

Thus, the '239 patent does not render the claimed invention anticipated or obvious. It is therefore submitted that amended claims 7-12 are patentable. Applicants respectfully request reconsideration and withdrawal of the rejection of claims 7-12 over the '239 patent under 35 U.S.C. § 102(b) and § 103(a).

CONCLUSION

It is submitted that in view of the present amendment and foregoing remarks, the application is now in condition for allowance. It is therefore respectfully requested that the application, as amended, be allowed and passed for issue.

Respectfully submitted,

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